One depuratory system cannot, therefore, compensate for deficient function in another only so far as the elements conveyed to it are identical with those of its own secretion.

The blood gives each tissue the means of repairing itself: first, by furnishing it with material of new growth; secondly, by removing from it those elements of its composition which have become worn out and useless. Were this the whole history of the blood, its investigation in disease would be comparatively easy. But it undergoes progressive changes analogous to the growth of the solid tissues. The new materials it obtains from the food are not blood at the time of their addition; they are crude immature products which subsequently mature.

The automatic nervous system endows the blood with a power to resist changes, convert crude material into its own elements, and perpetuate its own elementary composition and molecular arrangement. Physiology teaches that the abundance of cell development measures the activity and constancy of growth; and that this developmental activity in the blood is infinitely greater than in any other tissue. Cell-germs abound in the fluid of the thoracic duct. But they attain their maturity and fulfil the purpose of their creation only when received into the blood.

Not only does the blood grow, but its growth must precede that of every other tissue in the organism. It grows, then the other tissues grow at its expense.

Its functions in health will show sufficiently what peculiar difficulties attend any investigation of its changes in disease. The extreme rapidity with which all its changes transpire, and the minute quantities in which several ingredients exist, oppose great obstacles to the research; but these are greatly enhanced by the physiological fact that all the elements of the blood correspond to different periods of time, to different degrees of development, and to different developmental cells.

Viewed as an object of scientific research, human life exhibits itself in a series of manifestations, the connection and recurrence of which are determined by the changes which the food and the oxygen absorbed from the atmosphere undergo in the organism under the controlling influence of the automatic nervous system; for the first condition of life is the assimilation of nutritive material, and the second is that of a continual absorption of oxygen from the atmosphere. The intensity, the integrity, the quantity, and the quality of the molecular combinations and rearrangements of the elements of the blood depend on the mutual action of the oxygen of the atmosphere and the elementary constituents of the food.

The most convincing experiments have proved that the human organism is absolutely incapable of producing an elementary constituent, such as carbon or nitrogen, out of substances which do not contain it; therefore it follows that all kinds of food, to produce the tissues and maintain them in a normal relation with each other, must possess the elements of which the tis-

sues are composed. Fibrin and albumen, the chief ingredients of the blood, contain seven chemical elements, among which are oxygen, carbon, hydrogen, nitrogen, phosphorus, and sulphur. The serum retains in solution sea salt and the salts of potassa and soda, in which the acids are carbonic, phosphoric, and sulphuric.

The globules of the blood contain fibrin and albumen, with a red colouring matter in which iron is a constant element. They are formed out of the elements contained in the serum; because it is the atmosphere, and supplies the material for cell development, which is constantly taking place within this fluid. Hence it is the most important branch of hæmatology.

The chief constituents of the blood are compounds, in which the relative proportions are invariable. These compounds are the nascent states of the tissues, and maintain a relation of mutual dependence on each other. The blood could not become organized, nor could it promote the growth of tissues without the existence of albumen in the serum; because the globules are developed in this fluid at the expense of its albumen, and they carry the oxygen which they absorb from the atmosphere into every tissue of the organism, where it determines the changes which may transpire.

Oxygen is necessary to the growth and maturity of the tissues; it is necessary for their conservation; and it is necessary for their conversion into lifeless compounds; but it can only be introduced by the agency of the globules. These can only attain a condition favourable to the reception and conveyance of the oxygen at the expense of the primary elements of the blood, which are obtained from the elementary constituents of the food.

The absorption of oxygen and the secretion of carbonic acid gas constitute the visible functions of respiration, and the vast absorbent and secretory capacity of the lungs depends on the immense expanse of absorbent and secretory cells brought in proximity to the oxygen of the atmosphere at each inspiration, and on the quantity and quality of the molecular combinations of the elements of the blood which are developed during that period.

The food must contain and supply the elements of which the blood is composed; they must undergo normal transformation; they must grow and mature normally, before the necessary quantity of oxygen can be absorbed to consume them by combination. For a more enlarged consideration of this interesting subject the reader is invited to an essay in the *American Journal of the Medical Sciences*, for July, 1855, on the Physiology of the Automatic Nervous System, in which I maintain the unity and mutual convertibility of all the different forms of external force and of all the different forms of the automatic nervous force, and to another essay in the same Journal for April, 1856, in which I endeavour to show the causes of fever, and explain the mode in which they produce diseased transformation of the tissues.

*Pathology.*—From these physiological facts, it is evident that fever may assume a vast multiplicity of forms, which are manifested by characteristic symptoms. These have often been *mistaken* for the disease itself; and the

error has been magnified and perpetuated by giving them *names* which have been commemorated by *learned* authors. Symptoms are like sentinels on duty; they guard the organism, evince the existence of disease, indicate the avenues of its approach, and the degree of resistance offered by the organism, manifest its progress, portray its pathology, and proclaim its triumph or announce its extermination. Clothed in the attire of fancy, marshalled by the mandates of theory, mantled by the nomenclature of authors, they are often received and entertained in the mansion of affliction instead of the disease.

*Fever is a diseased transformation of all the tissues;* but the fluid tissues suffer the most, because the solid tissues are formed in them and of them. The blood contains not only the nutritive elements, but also the effete constituents of the transformed solid tissues. Both the nutritive and the effete elements are formed, matured, and appropriated by cellular combinations.

These are the agents of the automatic nervous force acting on the organizable constituents of the food, and blood, or upon the organizable elements of the transformed tissues.

The activity, the quantity, and the quality of the molecular combinations depend on the intensity and integrity of this force, manifested as nutritive attraction, molecular affinity, and effete repulsion. The nascent states of this force in any of these forms are easily transmuted; and both the developmental cells and the molecular combinations, to the formation of which it contributes, as the formative or organizing force, will partake of the abnormal mutation. Hence the vast number of symptoms which arise during the incipiency and course of fever. The cells of nutrition neither grow nor mature normally; nor are their constituents appropriated to the nutrition of the tissues normally. From the diminished quantity and feeble intensity of the organizing force of the automatic nervous branches of the digestive and assimilative organs, the organizable elements of the food are not decomposed, transformed, rearranged, and absorbed in normal quantity and quality; only a small amount of nutritive material is received by the lacteals out of which blood may be formed and developed; and the molecular combinations of the cells, containing this, are so imperfect, that they cannot undergo mutations with normal force and celerity.

Imperfectly developed by molecular combination, the nutritive constituents of the blood often aggregate in some of the capillaries, in which they then constitute excessive and perverted nutrition, or inflammation. This is of frequent occurrence during the progress of fever, and merits the anxious and careful consideration of the physician.

During fever the secretory cells are neither formed, developed, nor matured normally; nor are the elements which they should normally aggregate and elaborate depurated from the blood; because the nutritive elements neither absorb a normal quantity of oxygen from the atmosphere, nor does that which is received undergo normal molecular combinations on account of their imperfect molecular development.

The imperfectly combined oxygen, when it is not consumed by molecular combination with the protein elements of the blood, acts upon those elements of the solid tissues, exciting the sensation of *pain*, when it consumes branches of the sensitive nervous tissue, producing *irregular* and *involuntary* muscular actions, when it consumes those of the excito-motory, and creating the sensation of *thirst, oppression*, and *suffocation*, when it consumes only those of the automatic nervous system.

During the incipiency of fever, the effete elements of the blood, therefore, undergo a series of abnormal transformations, and are chiefly retained in the blood; a lesion of nutrition and secretion exists, the organizing force of the automatic nervous system, which, in a normal state, creates, maintains, and governs the cellular formation and coalescence of the elementary constituents of the blood is increased, decreased, or perverted; there is a lesion of capillary circulation; the blood recedes from the external capillaries and accumulates chiefly in the portal venous system; a diseased transformation of all the tissues is present; *Fever exists;* it is manifested by symptoms; these assume a great multiplicity of appearances and forms, according to the pathological condition of the tissues.

There is no longer a perfect equilibrium between the processes of waste and repair; neither a normal quantity of food is desired, nor could it be assimilated, were it ingested; every tissue, therefore, suffers for appropriate nourishment.

Those more immediately concerned in the processes of nutrition most early evince the requirements of food, or the necessary elementary constituents for the repair of their tissues.

As the automatic nervous system creates, governs, and maintains all the tissues by its organizing force acting on the organizable elements of the food and blood, it is the first tissue to manifest the want of nourishment by lesion of the different forms of its force.

Quinine supplies nutritive elements to this tissue, and by this gives its different forms of force increased intensity. Its physiological effects on the organism are an increase of the developmental intensity and celerity of the cells, and a promotion of their molecular combination and coalescence, by which the transformation of the nutritive cells is increased, and those of secretion augmented. When a diseased transformation exists, it should, therefore, be carefully administered, and its effects sedulously investigated.

In the June No. of the *Cincinnati Medical Observer*, for 1857, I have given my views of the use of quinine in fever; and in the July No. of the *American Journal of the Medical Sciences* for 1857, I have discussed, at some length, the use of water in fever.

In the latter essay I have maintained that the hydrogen of the water combines with the imperfectly combined oxygen in the blood, forms water, and is removed from the blood in the form of sweat or perspiration; while the

oxygen of the water combines with the carbon of the blood, evolves heat, and is secreted in the form of carbonic acid gas.

The attention of the reader is invited to each of these essays.

After the employment of appropriate remedial agents, and the removal of the more manifest symptoms of fever, there often remains an impoverished condition of the blood, which is a fertile source of local dependent forms of disease, especially when, during the progress of fever, a chill from time to time occurs. This condition of the blood is *sensitively* evinced by lesion of nutrition, loss of nervous energy, want of appetite, muscular debility, and more or less perversion of secretion; and *it is caused by deficient developmental intensity of the molecular combinations of the elements of the blood.*

The large proportion of albumen generally found in this morbid condition of the blood, is the result of defective cell-growth; because there is more nutritive material in the serum than could have remained there, if the normal proportion of blood-cells had been developed out of it. The evidence is, therefore, almost conclusive, that the albumen which exists in the blood does not grow and mature normally, or it would be consumed by molecular combination.

The causes of fever, how slight soever they be, retard the developmental intensity and activity of the blood cells; and if they be long continued, frequently repeated, or of great disturbing force, they impair the normal molecular changes of the blood, and transmute them, with more or less celerity, into the different forms of chemical force, when life may soon become extinguished. If the abnormal mutations be arrested, a period of time must transpire before the different forms of the organizing force of the automatic nervous system can attain normal tranquillity and intensity; because the tissue of this system has suffered for normal nutrition; and its different forms of force have been so disturbed and so transmuted, that time is required for them to regain normal intensity and a controlling influence over the molecular combinations of the blood.

When this is obtained, all the forms of the organizing force are united in purpose, harmonious in action, and conspire to promote the conservation and well-being of the organism. But they require organizable elements to elicit their action; and the lesion of nutrition opposes the attainment of this grand object by not supplying all the constituents necessary to the developmental intensity of the blood-cells.

Although so minute, these cells always act harmoniously; they elaborate the constituents of the blood in a continued series of succession; each performs a definite and distinct duty; but the blood must contain all the elements, of which the tissues are composed, or these cells cannot be normally transformed and rearranged; they cannot grow and mature normally, because the absence of a single organizable element would disturb the unity of purpose and the concert of action between the different forms of the organizing force, and thereby impede the molecular growth and development of the whole. This

is precisely what always transpires during the incipiency of fever; and it is perpetuated throughout its course. The lesion of nutrition may be slight, but it is sufficient to produce and maintain the continued absence or immature condition of one or more constituents of the tissues.

The development of the blood must, therefore, be imperfect; and this imperfection will always be commensurate with the degree and duration of the nutritive lesion.

The dependence of the capillary circulation upon the normal molecular combinations of the elements of the blood always produces a lesion of this circulation proportionate to the abnormal mutations, which transpire from imperfect development of the globules.

There is, therefore, always present more or less anæmia in fever; because the morbid changes of the molecular combinations of the constituents of the blood prevent its introduction into the capillaries in normal quantity by *nutritive attraction;* and although the arterial system may be bounding and throbbing, these vessels convey an absolutely diminished quantity of blood to the capillaries.

The mechanical force of the muscular action of the heart and arteries is derived from the cellular changes of the elements of the blood at the ultimate termination of their muscular fibres; so that it must be diminished in intensity when these molecular mutations do not take place with normal force and celerity from deficient development of the globules.

Enfeebled action of the heart and arteries is, therefore, always present in fever. Their mechanical force is diminished; they only propel a quantity of blood to the external capillaries equal to their propulsive intensity; and as this is not equal to the whole quantity of the blood, a certain portion must regurgitate from the heart, at each systole, into the portal venous system.

The morbid accumulation of blood in this venous system produces an anæmic state of the external capillaries.

These abnormal states of the circulation perpetuate fever, because only a small quantity of nutritive material can be elaborated and introduced into the blood on account of the capillary lesions; and the molecular mutations of the blood in the depuratory glands are, consequently, so abnormal, that what already exists is very imperfectly depurated.

Only a limited quantity of oxygen is absorbed; but that which is received is not normally consumed by combination. Imperfectly consumed by combination, it combines with the solid tissues, producing their death and decomposition by conversion into lifeless compounds.

Fever, attended by the symptoms which arise from these states of the solid and fluid tissues, is called typhus or typhoid. It is frequently observed in the southwestern States in the autumn, when the days are hot and the nights cool, especially if fever with intermittent symptoms prevailed during the preceding summer.

Throughout the southwestern States, fever, with chills at irregular periods,

is often of protracted duration; and, during its course, the spleen is liable to become hypertrophied, and the blood poor and attenuated. When the spleen is greatly hypertrophied, and soft and yielding upon pressure, large granular globules, two or three times the size of the natural colourless corpuscles, may frequently be observed in great abundance in the blood; and usually the ordinary colourless corpuscles are in great excess in this condition of the spleen. Southwestern physicians, who have *unfortunately* employed bleeding from a large orifice in the treatment of inflammation of the lungs, when the spleen is in this pathological condition, can bear witness to the frequency of these appearances of the blood.

When this pathological state of the blood exists, the hepatic functions are always more or less disturbed by the morbid accumulation of blood altered in quality in the hepatic capillaries. This disturbance, when it is of long duration, is usually manifested by a yellow appearance of the skin, clay-coloured discharges from the bowels, and scant high-coloured urine, alternated with green fetid evacuations from the bowels, and large quantities of yellow sedimentary urine.

A serous diarrhœa sometimes supervenes upon these conditions, when the sufferer is rapidly exhausted by the continuous drain of serum. Cruveilhier, Becquerel and Rodier, Andral and Gavarret, have conclusively shown that the attenuation of the blood by bleeding decreases the quantity of the corpuscles, while the other constituents undergo little change in their proportion either to each other or to the entire mass.

The same law prevails in respect to hemorrhage and many exhaustive forms of disease. The attention of the profession is particularly invited to menorrhagia, as it affects women who reside on our southwestern alluvion *bottoms*. With them the hemorrhage often alternates with serous diarrhœa, when general anæmia is soon produced and pervades every tissue of her organism.

The human female has a peculiar law of blood-development. During about thirty years of her life she forms blood enough for herself and an infant. If she be pregnant or suckling, this redundant blood formation fulfils its purposes by nourishing her organism and that of her infant; but if she be neither pregnant nor suckling, the large blood formation, which is normal to her for these purposes, becomes excessive in their absence, and tends to effect its own cure by means of recurrent hemorrhage from the mucous membrane of the uterus, which attends the discharge of unfertilized ova from the Graafian vesicles, and constitutes menstruation when it is normal, and menorrhagia when it is abnormal from the excessive quantity of blood discharged. Lesions of this process most usually occur from general causes affecting the development of the blood; and among these, in the southwestern States, the most universal are those vicissitudes of the atmosphere which produce fever. The morbid influences of the climate or locality impoverish the blood and produce the pathological conditions which arise from the want of cell development of the blood-corpuscles.

The anæmia which so often takes place about the period of puberty in young women in the western States, consists essentially in deficient growth of blood-cells; and it is of much more frequent occurrence than is generally apprehended. During the autumn, teething children often suffer of a serous diarrhœa of protracted duration. This is perpetuated by the want of developmental activity of the globules.

The physiological effects of iron conclusively evince, that it promotes the development of the blood-cells and accelerates their maturity. This is in accordance with a general law of the human organism, that the specific stimulants of cell growth in every tissue are elements identical with the natural contents of the cells, or convertible into them.

The globules of the blood contain increments of iron obtained from the food; and from the physiological fact that these are always present in normal blood, it is self-evident that iron is absolutely necessary to animal life.

From the physiological fact that the globules do not contribute to the nutrition of the tissues until they have attained maturity; that they will not mature normally without certain increments of iron; that when these are normally present they greatly promote the developmental intensity and activity of the blood-cells; that they increase the capacity of these cells for the absorption of the oxygen of the atmosphere and for the secretion of carbonic acid gas from the blood, by which the globules assume a bright-red colour; that the blood in this manner oxidized is conveyed and introduced into the capillaries, in which its elements are transformed, matured, and appropriated to the nutrition of the tissues, evolves animal heat, and absorbs the effete constituents of the transformed tissues; and that the pathological states which are produced are those which are dependent on imperfect molecular development of the globules, and the consequent deficient oxidation and depuration of the blood; we can appreciate the causes of the perverted condition of the different forms of the automatic nervous force, the abnormal forms this force assumes in the molecular combination of the elements of the blood, when all development is deficient, and the best means to effect its tranquillity and early restoration.

Iron is the most efficient agent to promote the normal restoration of these lesions, because it supplies the element required to promote the growth and maturity of the protein globules. The effects of few medicinal substances are more immediate or more remarkable than that which results in disease from deficient cell development from the exhibition of iron.

Every physician has observed how soon, under the influence of this remedy, patients recover their natural complexion. A chemical analysis of the blood explains this sufficiently. F. Simon relates a case in which, after a few weeks of treatment, the proportion of blood globules rose from 32 to 95 in the thousand; Herberger, one in which it rose from 38 to 98; Andral, one in which it rose from 46 to 95.

Iron is seldom administered in a metallic state. It is usually oxidized, and

combined with a vegetable or mineral acid. The compounds formed by combination of iron with the vegetable acids are less powerful and efficient than those by mineral acids. The citrate and tartrate of iron are mild in their action, and they may, therefore, often be given before the stronger compounds. We not unfrequently observe that the stronger compounds of iron, when first administered, apparently increase all the anæmic symptoms, especially those referable to the stomach and head. The potassio-tartrate of iron may be given along with the bitartrate of potassa, when there is œdema of the ankles, or of the cellular tissue generally. This is a valuable compound of iron in the anæmia of females, when there is local effusion in the cellular tissue.

Several of the compounds of iron are often given in larger doses than is necessary when the design is to promote the absorption of the iron into the blood. This observation applies especially to the carbonate, sulphate, and muriated tincture. The regeneration of the globules, when much diminished in quantity and altered in quality, must require considerable time.

That the efficacy of a ferruginous compound is not in proportion to the quantity of iron it contains is shown by the fact that many mineral waters are very powerful, though they contain less than a grain in the pint. This fact clearly evinces the necessity of the greatest care in the selection of the compound we are about to employ; because the efficacy of iron often depends on the compound used and its mode of administration. Deficient cell-growth, which occasions the necessity for the employment of iron, causes a vast multiplicity of symptoms, which are produced by the functional disturbance of the visceral glands. The compound of iron should, as nearly as possible, be adapted to the particular state of the digestive organs, that it may be readily absorbed and elaborated with the nutritive elements of the blood; for this is the only mode by which iron can promote the growth and maturity of the blood. Sir James Murray first recommended the administration of iron in the following mode: Dissolve one drachm of the bicarbonate of soda in four ounces of water; then add to this one drachm of the muriated tincture of iron. The draught should be taken during effervescence. It should be repeated three or four times a day. Although the quantity of iron is small, yet it is in a state of subdivision so minute as to favour greatly the absorption of each increment. The double decomposition which takes place forms, as one of its products, muriate of soda. This saline is most congenial to the development of the globules.

During the protracted continuance of fever, diarrhœa, dysentery, or any other form of disease, during the autumn or winter in the Southwest, the use of iron according to this suggestion of Sir James Murray, is often attended with the greatest efficacy, especially when the fever, or other form of disease, assumes what is usually termed a typhoid form. The iron should be administered every three or four hours, alternated with other appropriate remedies. The minute quantities of iron and muriate of soda thus presented to the digestive and absorbent glands, which have been so long deranged and weak-

ened, stimulate and promote the growth and maturity of their cells, and thereby favour the digestion and accelerate the absorption of any nutritive or medicinal substance. This will be clearly evinced by the increased secretion, which will take place in a day or two from the beginning of the use of the iron. The biliary, urinary, and cutaneous secretions will be greatly augmented; the tongue will become more moist, the thirst less urgent, and the sleep more tranquil.

When inflammation exists, iron should be used cautiously and carefully. When fever, dysentery, or diarrhœa assumes what is called a *typhoid* state, iron is of the greatest efficacy, because it stimulates and promotes the growth and maturity of the blood-cells. The matured blood-cells absorb and elaborate more oxygen from the atmosphere; an increased transformation of the elements of the blood ensue; the capillary circulation is accelerated and augmented, and increased secretion from all the depuratory glandular systems takes place.

When a typhoid state exists in any form of disease, western physicians have often prescribed for several days without observing scarcely any effect from the medicine they had directed. Let them employ iron, as here directed, and, in a day or two, each medicinal article will begin to manifest its characteristic effects on the organism.

Muriated tincture of iron is a very efficacious compound in the treatment of menorrhagia. Its use should be continued for a considerable time. It may often be employed with the greatest advantage in fever with typhoid symptoms.

*Iodide* of iron is a preparation which combines in some degree the properties of iodine with those of iron, though the latter predominate. It seems to promote the secretions more than any other compound of iron. When it is not too stimulating it is one of the best tonics in the anæmia of phthisis and scrofula; and from my experience of its effects in these affections in this climate, it is *never* too stimulating. It may be advantageously employed in all cases of anæmia combined with enlargement of the lymphatic glands. It changes the molecular condition of indurated glands and promotes their absorption. It may be used advantageously in the chronic form of *many* diseases, in which calomel *should* have been employed during the acute state.

The citrated aromatic wine of iron possesses the most agreeable odor and taste of any medicinal compound of iron. It is seldom rejected by the most delicate stomach. I have directed it for children and young persons in various forms of disease with debility, and I have never found it disliked or rejected, and its repetition is most generally desired.

When excessive secretion from a relaxed state of the mucous membrane in chronic bronchitis exists, combined with wine of ipecacuanha, it is of peculiar efficacy. In all diseases which arise from deficient developmental activity of the blood-cells, it is a remedy of great value. There are many

other compounds of iron of peculiar value and great efficacy; but I cannot extend the limits of this paper by a definite notice of them.

When we contemplate the effects of the climate of the alluvion districts in the southwestern States in the production of an impoverished condition of the blood, the frequency with which this state of the blood is met with in these localities, and its injurious consequences to the organism when allowed to continue, the value of iron in the promotion of the growth and maturity of the blood-cells, and the consequent removal of this condition of the blood, can scarcely be sufficiently appreciated.

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ART. IV.—*Glycerine as a Local Application in Pseudo-Membranous Croup.* By E. R. MAYER, M. D., of Wilkesbarre, Pa.

I HAVE lately, on several occasions, made use of glycerine as a local application in the treatment of membranous croup, with such apparent advantage as to lead me to think its employment as an aid to the management of this formidable disease, worthy of recommendation to the notice of the profession.

I was induced to make a trial of this liquid from having frequently observed the great relief obtained by its being snuffed up or injected into the nostrils in those frequently encountered forms of ozænoid disease in which the excretion hardens and dries, forming solid plugs or tubular casts of the nasal fossæ, analogous in compactness and tenacity, if unlike in composition and mode of formation, to the false membrane of croup. In such cases, the injection of warm water often fails to enable the patient to get rid of the accumulation; but the contact of a little glycerine is soon followed by the expulsion of the offending substance in a softened state and by relief of the irritation caused by its presence.

Glycerine is not only remarkable for its bland, solvent and undrying properties, and the completeness with which it sheathes surfaces exposed to its action, but for its wonderful power of adhesion, extension and penetration, particularly when applied to a mucous surface. These latter properties it has in so great a degree, that it is only necessary to apply it to a portion of a continuous secreting surface in order to secure its rapid contact with other adjacent parts of the same which may not be within reach of its convenient application. To effect its introduction into the larynx, for instance, it is not absolutely necessary to use the modes of local laryngeal medication now so much in vogue, however advantageous these may be; for its mere apposition, in any quantity, to the rima glottidis, or to the nearly adjoining surfaces, is followed by its immediate entrance into the cavity, without provoking, to any extent, the spasm and violent convulsive cough always caused by the forcible introduction of a probang sponge into the orifice. An evidence of the facility